MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

Landsat 7 Mission Operations Center (MOC) to Image Assessment System (IAS) Interface Control Document

October 1997

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

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Approved by:

_____   Date
W. J. Potter
Landsat 7 MOC Systems Manager
Code 511

_____   Date
L. Kidd
Implementation Manager
Code 510.1

_____   Date
J. Heneger
IAS Project Manager
Code 514.1

Goddard Space Flight Center
Greenbelt, Maryland

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to Image Assessment System (IAS)
Interface Control Document

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Prepared by:

K. Hughes   Date
CSC

Reviewed by:

C. Bauer   Date
Element Lead, Landsat MOC, CSC

S. Johnston   Date
IAS Systems Engineer, SSAI

Quality Assured by:

S. Whisonant   Date
Product Assurance Officer, CSC

Approved by:

J. Lauderdale   Date
Element Manager, Landsat MOC, CSC

M. Samii   Date
Technical Area Manager, Landsat 7, CSC

Goddard Space Flight Center
Greenbelt, Maryland

Preface

This document has been baselined by the Mission Operations and Systems Development Division (MOSDD) Configuration Control Board (CCB). Proposed changes to this document shall be submitted, along with supportive material justifying the change, to the Landsat 7 Mission Operations Center (MOC) Systems Manager. Changes to this document shall be made by document change notice (DCN) or by complete revision.

The change bars in this version of the document indicate errata authorized when the document was baselined, as well as additional changes approved by the Landsat 7 Ground System (GS) CCB.

Questions or comments concerning this document shall be addressed to

> Landsat 7 MOC Systems Manager
> Code 511
> Goddard Space Flight Center
> Greenbelt, Maryland 20771

Abstract

This interface control document (ICD) between the Landsat 7 Mission Operations Center (MOC) and the Image Assessment System (IAS) defines the interface according to the Open Systems Interconnection (OSI) communications reference model. Section 1 provides an overview and background of the interface. Section 2 describes the system components of the interface and summarizes the data flow between the two. Sections 3 through 9 describe, respectively, the application, presentation, session, transport, network, data link, and physical layers that make up the interface.

Keywords: Image Assessment System (IAS), interface control document (ICD), Landsat 7, Mission Operations Center (MOC), Open Systems Interconnection (OSI) model

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Section 1. Introduction

1.1   Purpose

This interface control document (ICD) defines the interface between the Landsat 7 Mission Operations Center (MOC) and the Landsat 7 Image Assessment System (IAS).

1.2   Scope

In this document, networking activities are divided into two groups: user-oriented or application services and communications-oriented or transport services. User services are concerned with the formatting and interpretation of data; transport services deal with the actual transmission of the information from one system to another.

There are seven layers within this architecture structure. The upper three layers (application, presentation, and session) are associated with user services and encompass the protocols necessary to allow two dissimilar applications or operating systems to understand each other and communicate. The fourth layer (transport) isolates the upper layers from the detailed workings of the lower, network-dependent layers. It provides for reliable data transmission regardless of the nature or reliability of lower layers. The lower three layers (network, data link, and physical) are hardware specific and encompass the protocols used to interface the data communications network with the two processors exchanging information.

To the extent possible, this ICD follows the guidelines provided by the National Aeronautics and Space Administration (NASA) in the *Handbook for Preparing Interface Control Documents for Non-Project Related Ground Facilities* (Reference 1 in Section 1.5). The guidelines have been adapted to conform to the International Organization for Standardization (ISO)/Open Systems Interconnection (OSI) network communications reference model.

1.3   Document Control

This document has been baselined by the Mission Operations and Systems Development Division (MOSDD) Configuration Control Board (CCB). Suggested or recommended changes to this ICD should be submitted to the Landsat 7 MOC Systems Manager, who will oversee their review by the elements affected by the changes. Changes agreed to by these elements shall be distributed under the direction of the Systems Manager.

1.4   Document Organization

Section 1 contains a statement of purpose and definition of the scope of this ICD. Information is provided regarding document control, organization, and supporting documents used to develop and maintain this document.

Section 2 describes the systems and the role of the interface to which this ICD applies.

Section 3 describes the application layer, which contains most user-supplied functions, the network control program, and a network management module for interactive access to the lower layers.

Section 4 describes the presentation layer, which converts data to a common format to facilitate communication between varying systems.

Section 5 discusses the session layer, which provides services such as synchronization checkpointing and error recovery to aid the orderly flow of data.

Section 6 discusses the transport layer, which provides end-to-end data integrity and quality of service functions and which assembles and disassembles packets for the network layer.

Section 7 describes the network layer, which switches and routes data transparently between computers.

Section 8 addresses the data link layer, which transfers data units to the other end of a physical link and maintains data integrity between network nodes.

Section 9 describes the physical layer, which provides bit-stream transmission over a physical medium.

Appendix A provides sample files and is followed by a list of abbreviations and acronyms used in this document.

1.5   Applicable Documents

1.   National Aeronautics and Space Administration (NASA), Goddard Space Flight Center (GSFC), STDN No. 102.8, *Handbook for Preparing Interface Control Documents for Non-Project Related Ground Facilities*, 1981

2.   --, 553-FDD-95/003R1UD0, *Landsat 7/Flight Dynamics Facility Interface Control Document*, *Revision 1*, September 1997

3.   --, 511-7UG-0996, *Generic Trending and Analysis System (GTAS) Release 5 User's Guide*, August 1996

4.   --, 430-15-01-002-0, *Landsat 7 Calibration Parameter File Definitions and Formats*, May 1997

5.   --, 430-11-06-009-00, *Landsat 7 to International Ground Station (IGS) Interface Control Document*, *Revision A*, September 1997

6.   *File Transfer Protocol*, MIL-STD-1780, May 1984

7.   The Wollongong Group, Inc., *WINS TCP/IP Primer*, June 1987

8.   *Transmission Control Protocol*, MIL-STD-1778, August 1983

9.   *Internet Protocol*, MIL-STD-1777, August 1983

10. Federal Aviation Administration (FAA), *NAS Open Systems Interconnection Implementation Requirements,* Draft, 1989

11. U.S. Department of Commerce, National Institute of Standards and Technology (NIST), FIPS Pub 146/XAB, *Government Open Systems Interconnection Profile (GOSIP)*, August 1988

12. --, FIPS PB90-111212/XAB, *GOSIP User's Guide*, 1989

13. --, Special Publication 500-162, FIPS PB90-212192/XAB, *Stable Implementation Agreements for OSI Protocols*, March 1990

14. NASA, GSFC, 510-1MGD/0291, *Mission Operations Division (MOD) Interface Control Document (ICD) Guidelines*, November 1991

15. --, 511-4SRD/0395 (CSC/SD-95/6043), *Landsat 7 Mission Operations Center (MOC) System Requirements Specification*, April 1996

16. --, 430-15-01-001-0, *Landsat-7 Image Assessment System Element Specification*, October 1996

17. --, *Image Assessment System Operations Concept*, December 1994

18. --, 430-11-01-003-1, *Landsat 7 Detailed Mission Requirements*, December 1996

19. --, 541-185, *Nascom Operational Local Area Network (NOLAN) and MODNET II Interface Control Document*, June 1993

20. Comer, Douglas E., *Internetworking With TCP/IP Principles, Protocols, and Architecture*. Englewood Cliffs, N.J.: Prentice Hall, 1988

Section 2. Interface Description

2.1   General

This section provides functional descriptions of both interfacing systems, identifies the types of data exchanged across the interface, and discusses interface security and voice communications.

2.2   Interface Description Overview

2.2.1   Purpose of the Interface

The purpose of the interface is to provide a mechanism to schedule the Enhanced Thematic Mapper Plus (ETM+) calibrations and to distribute the set of calibration coefficients to other Landsat 7 systems for use in processing Landsat 7 images into usable products. The interface also aids in diagnosing and correcting possible ETM+ problems.

The IAS sends the MOC calibration requests for ETM+ imaging. These calibration requests are of four types: full aperture calibrator (FAC), partial aperture calibrator (PAC), calibration lamp cycling, and ground look calibration requests. The MOC schedules the imaging and downlinking of the calibrations according to the time frame indicated in the IAS request and available downlink time at the Landsat 7 ground station (LGS).

As a result of analyzing the calibration scenes (as well as a select few other scenes), the IAS may determine that an update to the set of calibration coefficients is necessary. When updates to the set of coefficients are completed, the IAS sends these updates to the MOC in the form of the calibration parameter file. The IAS also measures the misalignment of the ETM+ for the Flight Dynamics Facility (FDF). As needed, the IAS sends the MOC the ETM+ misalignment data as part of the calibration parameter file. Once this file is received, the MOC distributes the calibration parameter file to the FDF and to all other Landsat 7 systems that need this data.

While processing Landsat 7 image data, the IAS may notice irregularities in the performance of the ETM+. As part of the analysis to determine the potential problem, the IAS sends the MOC a problem report asking for the MOC's assistance. The MOC responds with reports that specify the spacecraft status and a telemetry trending analysis.

Weekly, the MOC receives a contiguous history of daily definitive ephemeris data from the FDF. The MOC in turn sends the definitive ephemeris product to the IAS for use in geometric correction of the image data and in analysis of geometric correction performance. The MOC also sends the IAS the ascending node (AN) and descending node (DN) files already received from the FDF. The IAS uses these files to extract the orbit number. The MOC sends as needed or when requested an imaging impact report that informs the IAS when situations have been detected that could cause problems with imaging data.

2.2.2   MOC Description

The MOC, located at the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, is the focal point for all Landsat 7 satellite operations. The MOC plans and schedules the operation of

the spacecraft and its science payload, the ETM+. To schedule contacts with the satellite, the MOC works with multiple, existing operational resources, including NASA institutional facilities and the National Oceanic and Atmospheric Administration (NOAA). The MOC generates and validates real-time commands and stored command loads based on the conflict-free schedules. During a contact, the MOC sends the commands and loads to a ground station to be uplinked to the spacecraft. The MOC monitors the health and the status of the satellite using downlinked narrowband telemetry and analyzes the long-term performance of spacecraft subsystems.

2.2.3   IAS Description

The IAS is a system element located at the Earth Resources Observation System (EROS) Data Center (EDC) in Sioux Falls, South Dakota. As an element of the ground data handling segment, the IAS is responsible for the offline assessment of image quality to ensure compliance with the radiometric and geometric requirements of the spacecraft and ETM+ sensor throughout the life of the Landsat 7 mission. Operational activities occur at the EDC, and less frequent assessments and calibration certification are the responsibility of the Landsat 7 Project Science Office at GSFC.

2.3   Data Flow Summary

Figure 2-1 represents the data flow across the interface between the MOC and the IAS mapped into the ISO/OSI reference model.

2.4   Interface Security

The interface is implemented with commercial off-the-shelf (COTS) software that supports the File Transfer Protocol (FTP) over the Transmission Control Protocol/Internet Protocol (TCP/IP). The MOC is directly connected to the Mission Operations and Data Systems Directorate (MO&DSD) Operational/Development Network (MODNET)/NASA Communications (Nascom) Operational Local Area Network (NOLAN). Nascom will provide connections between the MODNET/NOLAN and the IAS network for MOC and IAS electronic communications.

The Landsat 7 MOC uses a primary local area network (LAN) segment for nominal operations and a backup LAN segment for contingency purposes (e.g., LAN failure or preventive maintenance). Because of the unique subnet addresses for each LAN segment, two host names are provided, each requiring a unique IP address. Therefore, in contingency mode, the backup Landsat 7 MOC IP address is required for end-to-end communications.

The IP domain, IP addresses, and host names are provided by the Landsat 7 MOC system administrator. The account names and passwords for receiving products from the IAS are provided at the time of operations. TCP/IP file transfer sessions are initiated by the IAS for
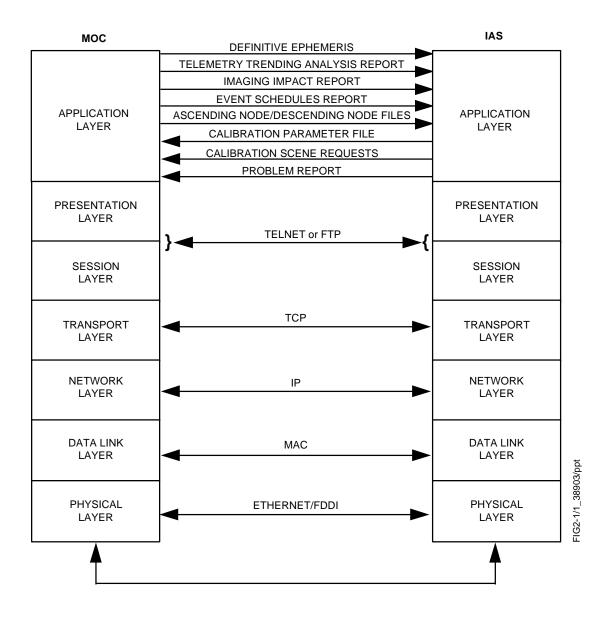
The figure shows the ISO/OSI layered model between MOC and IAS with the following layers and interconnections:

MOC (left) and IAS (right) layers: APPLICATION LAYER, PRESENTATION LAYER, SESSION LAYER, TRANSPORT LAYER, NETWORK LAYER, DATA LINK LAYER, PHYSICAL LAYER

Application layer flows (MOC to IAS):
- DEFINITIVE EPHEMERIS →
- TELEMETRY TRENDING ANALYSIS REPORT →
- IMAGING IMPACT REPORT →
- EVENT SCHEDULES REPORT →
- ASCENDING NODE/DESCENDING NODE FILES →
- CALIBRATION PARAMETER FILE ←
- CALIBRATION SCENE REQUESTS ←
- PROBLEM REPORT ←

Protocol interconnections:
- TELNET or FTP (between Presentation/Session layers)
- TCP (Transport Layer)
- IP (Network Layer)
- MAC (Data Link Layer)
- ETHERNET/FDDI (Physical Layer)

FIG2-1/1_38903/ppt

Figure 2-1. ISO/OSI Interface Reference Model

products transmitted to the MOC. The account name and password for transmitting products to the IAS are provided at the time of operations. TCP/IP file transfer sessions are initiated by the MOC for products transmitted to the IAS.

Because the MOC directly controls the spacecraft, the MOC must severely restrict outside access to the MOC hardware and software. The IAS will use FTP to send files to a MOC data server located outside the firewall that separates the open MODNET from the closed MODNET. The MOC will transfer the files from the data server to the MOC hardware inside the firewall.

2.5 Voice Communications

The telephone is the method of communication if either the MOC Flight Operations Team (FOT) or the IAS operator cannot transmit files to the other element.

Section 3. Application Layer

3.1   General

The application layer defines the user data transferred across the interface to all user interface applications. This section describes the data and performance requirements levied on the exchange of information between the MOC and the IAS.

3.2   MOC to IAS

3.2.1   Definitive Ephemeris

Landsat 7 definitive ephemeris is based on Tracking and Data Relay Satellite (TDRS) metric tracking data received from White Sands. A contiguous history of daily definitive ephemeris is built by the FDF, and updates are sent weekly to the MOC. When received from the FDF, the definitive ephemeris is sent to the IAS. The IAS uses the definitive ephemeris in geometric correction of the image data and in analysis of geometric correction performance.

3.2.2   Telemetry Trending Analysis Report

Part of the MOC baseline system is a tool called the Generic Trending and Analysis System (GTAS). The GTAS performs long-term trending analysis on the narrowband telemetry received in the MOC from the spacecraft. If requested through an IAS-generated problem report, the MOC FOT uses GTAS to generate a trending analysis report, which gives the IAS history on the telemetry parameters of interest, to help isolate and resolve the problem.

3.2.3   Imaging Impact Report

When the MOC FOT detects a problem related to the health and safety of the spacecraft or a situation on board the spacecraft that could cause problems with the image data obtained through the ETM+, the MOC FOT generates a report that relays this information to the IAS. Examples of such events include

- Offset pointing

- Leap second commanding

- Spacecraft anomalies

- Outgassing

- Spacecraft configuration changes

The MOC FOT also issues an imaging impact report in response to problem reports from the IAS (see Section 3.3.3).

3.2.4   Event Schedules Report

The MOC generates an event schedules report to inform the IAS as to when key events are planned. The event schedule is a time-based report containing events of interest to the IAS. To process the ETM+ science data, the IAS must know when events such as spacecraft maneuvers or calibration requests were scheduled. After the MOC FOT has generated the daily schedule, the event schedules report is generated and sent to the IAS.

3.2.5   Ascending Node/Descending Node Files

The AN/DN files are generated by the FDF and passed to the MOC weekly. Each file covers 4 weeks. The Landsat 7 orbit number is defined as a function of the AN crossing of the equator by the satellite. The AN and DN times and associated longitudes are used by the MOC throughout the mission for calculating Worldwide Reference System (WRS) scene center times and for monitoring ground track drift. When the MOC receives the AN/DN files, it sends a copy to the IAS. The IAS extracts the orbit number and time from the files.

3.3   IAS to MOC

3.3.1   Calibration Parameter File

The IAS evaluates and calibrates data from a subset of the received and processed ETM+ image data. The IAS determines if a geometric or radiometric calibration parameter update is required. If an update is needed, the IAS sends the calibration parameter file to the MOC for distribution to the international ground stations (IGSs) and the FDF. The IAS will always send the MOC the complete set of calibration coefficients within the calibration parameter file for distribution.

A function of the IAS is to calibrate the alignment of the ETM+ line-of-sight (LOS) to the Navigation Base Reference (NBR) frame. This calibration is done at least once during initial operations capability checkout and at 90-day intervals thereafter throughout the life of the mission. This calibration is accomplished by identifying known ground points and computing the difference between the expected location of these points in the ETM+ imagery and the actual location. If this comparison reveals ETM+ misalignment, the results are reported in a direction cosine matrix that is sent to the MOC as part of the calibration parameter file. The MOC then sends the FDF the calibration parameter file. The FDF uses the ETM+ misalignment data in the calibration parameter file to monitor and trend onboard alignment.

3.3.2   Calibration Scene Requests

To determine radiometric, geometric, and alignment calibrations of the ETM+, the IAS needs the MOC to schedule ETM+ imagery at special locations and times during the spacecraft orbit. Four types of IAS calibrations are planned: FAC, PAC, calibration lamp cycling, and ground look calibrations. During the normal phase of the mission, the IAS may request PAC calibrations and calibration lamp cycling once per day, FAC calibrations once every 5-6 weeks, and ground look calibrations as needed. However, calibration requests are more frequent during early orbit checkout.

3.3.2.1 Orbit-Based Requests

The IAS requests FAC and PAC calibrations based on a specific Landsat 7 orbit number.

3.3.2.2 WRS-Based Requests

The IAS requests ground look calibrations based on a set of WRS paths and rows.

3.3.2.3 Calibration Lamp Cycling Requests

The IAS requests the cycling of the ETM+ onboard calibration lamps based on a group of contiguous scenes.

3.3.3 Problem Report

As the IAS processes raw downlinked ETM+ image data to a complete level 1G Landsat product, statistics on the status of the ETM+ and data quality are maintained. Any perceived problems with the ETM+ or spacecraft are documented by the IAS and sent to the MOC through a problem report. This report requests the MOC to provide the IAS with an FOT-generated imaging impact report and optionally with a specific trending analysis report.

Section 4. Presentation Layer

4.1   General

The following subsections describe the format of the data to be transferred between the MOC and the IAS.

4.2   MOC to IAS

The products listed in this section are products produced by the MOC and sent to the IAS. The IP domain, IP address, host names, target directory, account names, and passwords are provided to the MOC by the IAS. The IAS polls the target directory for incoming MOC products.

4.2.1   Definitive Ephemeris

The FDF sends the MOC definitive ephemeris files. The files contain a contiguous history of daily definitive ephemeris. The contiguous history definitive ephemeris file is a weekly product delivered from the MOC to the IAS. The definitive ephemeris data are delivered to the IAS in the same format as the definitive ephemeris that the FDF sends to the MOC (i.e., the MOC does not modify the original FDF file before sending the definitive ephemeris to the IAS). The file format is described in the *Landsat 7/Flight Dynamics Facility Interface Control Document* (Reference 2).

The file-naming convention for the contiguous history definitive ephemeris file is

  L7yyyydddHISEPH.Snn

where   L7   is the mission ID

            yyyy   is the year in which the data were generated

            ddd   is the day of year when the file was generated (001-366)

        HISEPH   indicates that the file contains contiguous history definitive ephemeris data

            S   specifies the sequence number follows

            nn   is the sequence number of the file for that day (00-99); files with higher sequence numbers should be considered as replacements for previously received files with the same generation date

4.2.2   Telemetry Trending Analysis Report

When the IAS discovers a potential problem with the processing of ETM+ imagery to a level 1G product, they send the MOC an IAS problem report. The IAS report may ask the MOC FOT to perform trending analysis on specified, narrowband telemetry points over a given time. In response to this report, the MOC FOT (using GTAS) generates a telemetry trending analysis report that can be either plots or graphs. The telemetry trending analysis report is sent to the IAS

to assist in anomaly detection, isolation, and resolution. GTAS is designed to produce a variety of telemetry trending reports. All reports generated by GTAS are in American Standard Code for Information Interchange (ASCII) format. The file formats are described in the *Generic Trending and Analysis System (GTAS) Release 4 User's Guide* (Reference 3). Appendix A contains a sample telemetry trending analysis report.

The file-naming convention for the telemetry trending analysis report is

    L7yyyydddTRNDAN.Vnn

where		
	L7	is the mission ID
	yyyy	is the year in which the report was generated
	ddd	is the day of year when the report was generated (001-366)
	TRNDAN	indicates that the file contains a telemetry trending analysis report
	V	specifies the version number follows
	nn	is the version number of the file for that day (00-99); each file is unique and should **not** be considered a replacement for previously received files with the same generation date

4.2.3   Imaging Impact Report

When needed (see Section 3.2.3) or when requested by an IAS problem report (see Section 3.3.3), the MOC FOT manually generates an imaging impact report. The report notifies the IAS of events (scheduled or unscheduled) that impact imaging operations. These include offset pointing, leap-second commanding, spacecraft anomalies, outgassing, and spacecraft configuration changes. The report is also used to respond to queries posed by the IAS in a problem report. After the MOC FOT has generated the imaging impact report, the MOC FOT mails this report to the IAS electronically. The report is an ASCII free-format text file report whose format changes depending on the content. The report will always contain the time the report was generated and the time for each event being reported. The subject line of the mail message will contain the words 'Imaging Impact Report' and the date. Appendix A contains a sample imaging impact report.

4.2.4   Event Schedules Report

The MOC generates a daily event schedules report from the Mission Operations Planning and Scheduling System (MOPSS) timeline to inform the IAS when particular events are planned. The IAS needs the event times to perform ETM+ science data analysis. After the MOC FOT has generated the event schedules report, the MOC sends the report to the IAS. The report is an ASCII text file report whose format changes depending on the content. Appendix A contains a sample event schedules report. Events of interest to the IAS are time of maneuver commanding and PAC, FAC, calibration lamp cycling, and ground look calibration scenes.

The file-naming convention for the event schedules report is

L7yyyydddIASEVT.Snn

where   L7   is the mission ID

yyyy   is the year in which the report was generated

ddd   is the day of year when the report was generated (001-366)

IASEVT   indicates that the file contains an event schedules report for the IAS

S   specifies the sequence number follows

nn   is the sequence number of the file for that day (00-99); files with higher sequence numbers should be considered as replacements for previously received files with the same generation date

4.2.5   Ascending Node/Descending Node Files

The MOC receives the AN/DN files weekly from the FDF and sends them to the IAS. The file formats for the AN and DN files are described in the *Landsat 7/Flight Dynamics Facility Interface Control Document* (Reference 2).

The file-naming convention for the AN/DN file is

L7yyyydddxNODES.Snn

where   L7   is the mission ID

yyyy   is the year in which the file was generated

ddd   is the day of year when the file was generated (001-366)

xNODES   indicates the file type:

ANODES = ascending node file

DNODES = descending node file

S   specifies the sequence number follows

nn   is the sequence number of the file for that day (00-99); files with higher sequence numbers should be considered as replacements for previously received files with the same generation date

4.3   IAS to MOC

The products listed in this section are products produced by the IAS and sent to the MOC. The IP domain, IP address, host names, target directory, account names, and passwords are provided to the IAS by the Landsat 7 MOC system administrator. MOC software polls the target directory for incoming IAS products on the open server. After the MOC completes processing of a product received from the IAS, the MOC generates a product report, which is sent to the IAS. The report gives the processing status in the form of INFO messages (product processed successfully),

WARN messages (correctable errors encountered, product processed successfully), and ERROR messages (uncorrectable errors found, MOC unable to process product). The original product filename is used for the product report's filename, and an extension of IRPT, WRPT, or ERPT is added to the end of the filename [with no dot (.) before the new extension] to indicate the type of messages in the report.

4.3.1   Calibration Parameter File

Periodically, the IAS evaluates the calibration data gathered from processing ETM+ imagery against the current calibration parameters to determine if a calibration parameter update is required. Review of the calibration updates takes place within the research element of the IAS. If approved, the IAS provides calibration updates to the EDC Distributed Active Archive Center (DAAC), the Landsat 7 Processing System (LPS), and the MOC. It is the MOC's responsibility to provide the calibration updates to the IGSs and the FDF. The IAS always provides the MOC with a complete calibration parameter file. The IAS sends the calibration parameter file to the MOC several times during activation and nominally once per quarter during routine operations.

The calibration parameter file is in ASCII file format. The file format is described in the *Landsat 7 Calibration Parameter File Definitions and Formats* (Reference 4).

The file-naming convention for the calibration parameter file is

L7CPFyyyymmdd_yyyymmdd.nn

where   L7   is the mission ID

                                              CPF   indicates that the file is a calibration parameter file

                yyyymmdd_yyyymmdd   is the effective start date and effective end date, separated by an underscore

                                              nn   is the version number of the file within a quarter

4.3.2   Calibration Scene Requests

The IAS sends FAC, PAC, calibration lamp cycling, and ground look calibration requests for ETM+ imaging to the MOC. The MOC receives the requests, validates them, and inserts all valid requests into the MOC scheduling database for future scheduling. The IAS may request PAC and calibration lamp cycling calibrations once per day, FAC calibrations once every 5-6 weeks, and ground look calibrations as needed.

Three specific file formats are recognized by the MOC. The first format is for those calibration scene requests for ETM+ imagery that are based on a specific Landsat orbit number. This format is used for all PAC and FAC calibration requests. The second format is for those requests that are based on a set of WRS paths and rows. This format is used for ground look calibration requests. The file format for requests that are based on a set of WRS paths and rows is derived from the *Landsat 7 to International Ground Station (IGS) Interface Control Document* (Reference 5). The third format is for those requests that are based on a minimum cluster length. This format is used

for calibration lamp cycling requests. All formats for calibration scene requests are in ASCII file
format.

4.3.2.1   Orbit-Based Requests

The orbit-based calibration scene request begins with a 2-element header, as follows:

    TYPE: REQ

    DTG: yyyy/ddd:hh:mm:ss

Each element of the header consists of a single, fixed-format keyword followed by an ASCII
colon (:). The value for the element keyword follows the ASCII colon. Blank spaces are not
required to separate the element keyword from the data value, although they may be supplied for
readability. Each line is terminated by both an ASCII line feed character and an ASCII carriage
return character.

A description of the header elements follows.

TYPE is a 3-character field indicating that this message is a request for calibration scheduling.

DTG is a 17-character field that specifies the Greenwich mean time (GMT) date and time of the
message origination.

    1997 through 2100 = year (yyyy)

    001 through 366 = day of year (ddd)

    00 through 23 = hour (hh)

    00 through 59 = minute (mm)

    00 through 59 = second (ss)

The body of the orbit-based calibration scene request follows the standard header and is in the
following format:

Keyword	Format/Value	Description
S/C ID:	7	Indicates Landsat 7 is to be used to acquire the data
ORBIT:	xxxxx = 00000-99999	Specifies the orbit number (as defined by the FDF) for which this request is to be scheduled
GAIN:	abcdeLHfg where each character (abcdefg) is set as follows: H = high gain for the band L = low gain for the band or where Nine blanks = default gains	Indicates the desired gain for each of the ETM+ bands. This field is composed of a series of Hs (for high-gain selection) and/or Ls (for low-gain selection). There is one setting (H or L) for each band: 1, 2, 3, 4, 5, 6 (format 1), 6 (format 2), 7, and Pan, in order (e.g., HHLLHLHLH) **NOTE**: The requester can specify gains for all bands except band 6

Keyword	Format/Value	Description
GAIN: (Cont'd)		The MOC scheduler makes its best effort to provide the requested gain. This field may be left blank if the IAS accepts all default gain values for each scene requested as specified in the long-term plan (LTP)
		During scheduling, if there is also an archive refresh request for the same scene but with different gain settings, the IAS request will be scheduled, and the archive refresh request will be rejected
START ANGLE:	+/-xx.xx	Indicates that ETM+ imaging is to begin when the Sun angle relative to the Earth reaches the specified value during the previously specified orbit. The MOC determines the time of the start of ETM+ imaging based on the Sun Angle at WRS Scene Center FDF product (see Reference 2)
END ANGLE:	+/-xx.xx	Indicates that ETM+ imaging is to complete when the Sun angle relative to the Earth reaches the specified value during the previously specified orbit. The MOC determines the time of the end of ETM+ imaging based on the Sun Angle at WRS Scene Center FDF product (see Reference 2)
REQ. TYPE:	xxx = FAC, full aperture calibrator request = PAC, partial aperture calibrator request	Indicates the type of request the IAS wishes to send the MOC
LAMP SEQ.:	x = 0, both lamps off continuously x = 1, primary lamp on continuously, redundant lamp off x = 2, redundant lamp on continuously, primary lamp off x = 3, both lamps on continuously x = 4, lamp sequence or cycle is [10, 11, 01, 00] where 10 = primary lamp on, redundant lamp off 11 = primary lamp on, redundant lamp on 01 = primary lamp off, redundant lamp on 00 = primary lamp off, redundant lamp off	Indicates the cycling sequence of the ETM+ lamp states during the calibration activity

Keyword	Format/Value	Description
LAMP SEQ.: (Cont'd)	and the duration of each state is [10]—48 sec [11]—48 sec [01]—32 sec [00]—16 sec x = 5 through 9, reserved	

Because the MOC schedules ETM+ imaging requests on WRS scene boundaries, the MOC schedules the orbit-based IAS calibration requests to begin and end on WRS scene boundaries, along with associated scene header and trailer payload correction data (PCD). The MOC schedules imaging (and solid state recorder recording) to begin with respect to the nearest WRS scene boundary whose start scene boundary is just before or equal to the START ANGLE value specified in the request. The MOC schedules imaging (and solid state recorder recording) to end with respect to the nearest WRS scene boundary whose stop scene boundary is just after or equal to the END ANGLE value specified in the request.

The IAS may send as many different scene requests as desired within the orbit-based calibration request file. To send multiple requests within one file, only the body portion of the request needs to be repeated. If multiple requests are to be within a single file, each request must contain at least one blank line after the request body.

Following the body of the request is a standard message trailer. The message trailer consists of the single element "TEXTEND:". This provides a definite indication that there are no additional request lines in the file.

The file-naming convention for the orbit-based calibration scene request is

L7yyyydddIASORB.Vnn

where   L7   is the mission ID

yyyy   is the year in which the file was generated

ddd   is the day of year when the file was generated (001-366)

IASORB   indicates that the file contains orbit-based calibration scene requests from the IAS

V   specifies the version number follows

nn   is the version number of the file for that day (00-99); each file is unique and should **not** be considered a replacement for previously received files with the same generation date

4.3.2.2   WRS-Based Requests

The WRS-based calibration scene request begins with a 2-element header as follows:

> TYPE: REQ
>
> DTG: yyyy/ddd:hh:mm:ss

Each element of the header consists of a single, fixed-format keyword followed by an ASCII colon (:). The value for the element keyword follows the ASCII colon. Blank spaces are not required to separate the element keyword from the data value, although they may be supplied for readability. Each line is terminated by both an ASCII line feed character and an ASCII carriage return character.

A description of the header elements follows.

TYPE is a 3-character field indicating that this message is a request for calibration scheduling.

DTG is a 17-character field that specifies the GMT date and time of the message origination.

> 1997 through 2100 = year (yyyy)
>
> 001 through 366 = day of year (ddd)
>
> 00 through 23 = hour (hh)
>
> 00 through 59 = minute (mm)
>
> 00 through 59 = second (ss)

The body of the WRS-based calibration scene request follows the standard header and is in the following format:

Keyword	Format/Value	Description
S/C ID:	7	Indicates Landsat 7 is to be used to acquire the data
START PATH:	xxx = 001 - 233	Specifies WRS path associated with the first scene being requested
START ROW:	xxx = 001 - 248	Specifies WRS row associated with the first scene being requested
STOP ROW:	xxx = 001 - 248	Specifies WRS row associated with the last scene being requested
EFFECTIVE DATE:	yyyy-mm-dd where yyyy = 1997 - 2100 (year) mm = 01 - 12 (month) dd = 01 - 31 (day)	Specifies date on which the request becomes active for scheduling
EXPIRATION DATE:	yyyy-mm-dd (same as above)	Specifies the last date on which the request is eligible for scheduling. No acquisitions will be scheduled after this date
ACQ. RATE:	x = 0 for acquire every opportunity = 1 for acquire once only	Specifies rate at which acquisitions should be made; used in conjunction with MINIMUM GAP

Keyword	Format/Value	Description
MINIMUM GAP:	xxx = 000 - 366	Specifies minimum acceptable number of days between acquisitions

GAIN:	abcdeLHfg
	where each character (abcdefg) is set as follows:
	   H = high gain for the band
	   L = low gain for the band
	or where
	   Nine blanks = default gains
		Indicates the desired gain for each of the ETM+ bands. This field is composed of a series of Hs (for high-gain selection) and/or Ls (for low-gain selection). There is one setting (H or L) for each band: 1, 2, 3, 4, 5, 6 (format 1), 6 (format 2), 7, and Pan, in order (e.g., HHLLHLHLH)
		NOTE: The requester can specify gains for all bands except band 6
		The MOC scheduler makes its best effort to provide the requested gain. This field may be left blank if the IAS accepts all default gain values for each scene requested as specified in the long-term plan (LTP)
		During scheduling, if there is also an archive refresh request for the same scene but with different gain settings, the IAS request will be scheduled, and the archive refresh request will be rejected

MAX. SOLAR ZENITH ANGLE:	xx = 00 - 90 degrees = blank (use the default values)	Specifies maximum acceptable solar zenith angle If desired, this field may be left blank to trigger use of the default maximum solar zenith angle (85° TBR). The default setting is documented in the LTP During scheduling, the request will be rejected if the calculated solar zenith angle exceeds the maximum angle specified in the request
REQ. TYPE:	xxx = GLC	Identifies the type of request as IAS ground look calibration request
MAX. CLOUD:	xxx = 000-100 = blank (use default values)	Specifies maximum acceptable cloud cover If desired, this field may be left blank to trigger use of the default maximum cloud cover values in the LTP During scheduling, the priority of the request will be elevated if the predicted cloud cover is less than the maximum specified in the request. It will be lowered if the predicted cloud cover is more than the maximum specified in the request

Keyword	Format/Value	Description

LAMP SEQ.:	x = 0, both lamps off continuously
	
	x = 1, primary lamp on continuously, redundant lamp off
	
	x = 2, redundant lamp on continuously, primary lamp off
	
	x = 3, both lamps on continuously
	
	x = 4, lamp sequence or cycle is [10,11,01,00]
	where
	  10 = primary lamp on, redundant lamp off
	  11 = primary lamp on, redundant lamp on
	  01 = primary lamp off, redundant lamp on
	  00 = primary lamp off, redundant lamp off
	and the duration of each state is
	  [10]—48 sec
	  [11]—48 sec
	  [01]—32 sec
	  [00]—16 sec
	
	x = 5 through 9, reserved
		Indicates the cycling sequence of the ETM+ lamp states during the calibration activity

The IAS may send as many different scene requests as desired within the WRS-based calibration scene request file. To send multiple requests within one file, only the body portion of the request needs to be repeated. If multiple requests are to be within a single file, each request must contain at least one blank line after the request body.

Following the body of the request is a standard message trailer. The message trailer consists of the single element "TEXTEND:". This provides a definite indication that there are no additional request lines in the file.

The file-naming convention for the WRS-based calibration scene request is

    L7yyyydddIASWRS.Vnn

where   L7   is the mission ID

           yyyy   is the year in which the file was generated

           ddd   is the day of year when the file was generated (001-366)

       IASWRS   indicates that the file contains WRS-based calibration scene requests from the IAS

V   specifies the version number follows

nn   is the version number of the file for that day (00-99); each file is unique and should **not** be considered a replacement for previously received files with the same generation date

4.3.2.3   Calibration Lamp Cycling Request

The calibration lamp cycling request begins with a 2-element header, as follows:

TYPE: REQ

DTG: yyyy/ddd:hh:mm:ss

Each element of the header consists of a single, fixed-format keyword followed by an ASCII colon (:). The value for the element keyword follows the ASCII colon. Blank spaces are not required to separate the element keyword from the data value, although they may be supplied for readability. Each line is terminated by both an ASCII line feed character and an ASCII carriage return character.

A description of the header elements follows.

TYPE is a 3-character field indicating that this message is a request for calibration scheduling.

DTG is a 17-character field that specifies the GMT date and time of the message origination.

1997 through 2100 = year (yyyy)

001 through 366 = day of year (ddd)

00 through 23 = hour (hh)

00 through 59 = minute (mm)

00 through 59 = second (ss)

The body of the calibration lamp cycling request follows the standard header and is in the following format:

Keyword	Format/Value	Description
S/C ID:	7	Indicates Landsat 7 is to be used to acquire the data

EFFECTIVE DATE:	yyyy-mm-dd
	where yyyy = 1997 - 2100 (year)
	        mm = 01 - 12 (month)
	        dd = 01 - 31 (day)
		Specifies date on which the request becomes active for scheduling

MINIMUM ACCEPTABLE CLUSTER LENGTH:	nn	Specifies the minimum cluster length (number of scenes) during which to cycle the lamps
REQ. TYPE:	xxx = CYC	Indicates the type of request as an IAS calibration lamp cycling request

Keyword	Format/Value	Description
LAMP SEQ:	x = 4	Identifies the lamp sequence or cycle as [10,11,01,00] where 10 = primary lamp on, redundant lamp off 11 = primary lamp on, redundant lamp on 01 = primary lamp off, redundant lamp on 00 = primary lamp off, redundant lamp off and the duration of each state is as follows: [10]—48 sec [11]—48 sec [01]—32 sec [00]—16 sec

Following the body of the request is a standard message trailer. The message trailer consists of the single element "TEXTEND:". This provides a definite indication that there are no additional request lines in the file.

In response to the calibration lamp cycling request, the MOC will look for an existing cluster of scenes to be acquired that satisfy the parameters in the request. Once the scenes are identified by the scheduler, the gain mode of the two scenes at the beginning and ending of the cluster are altered, and the cluster is scheduled with the calibration lamps cycling throughout the duration.

The file-naming convention for the calibration lamp cycling request is

    L7yyyydddIASCYC.Vnn

where   L7   is the mission ID

            yyyy   is the year in which the file was generated

            ddd   is the day of year when the file was generated (001-366)

      IASCYC   indicates that the file contains a calibration lamp cycling request from the IAS

              V   specifies the version number follows

            nn   is the version number of the file for that day (00-99); each file is unique and should **not** be considered a replacement for previously received files with the same generation date

4.3.3   Problem Report

The problem report file is an ASCII free-format text file generated by the IAS. The report will always contain the time the report was generated. The file is made available to the MOC FOT to display or to print using the standard UNIX operating system features. The problem report file serves several purposes within the MOC-IAS interface:

- Mechanism for the IAS to request telemetry trending analysis reports and MOC FOT-generated imaging impact reports

- Mechanism for the IAS to inform the MOC FOT of potential anomalies in the science data that the MOC should investigate by examining narrowband telemetry

Appendix A contains a sample problem report file.

The file-naming convention for the problem report is

L7yyyydddIASPRB.Vnn

where	L7	is the mission ID
	yyyy	is the year in which the report was generated
	ddd	is the day of year when the report was generated (001-366)
	IASPRB	indicates that the file contains a problem report from the IAS
	V	specifies the version number follows
	nn	is the version number of the file for that day (00-99); each file is unique and should **not** be considered a replacement for previously received files with the same generation date

Section 5. Session Layer

5.1   General

The session layer provides system-dependent, process-to-process communications functions, which include

- Receipt and processing of incoming and outgoing logical link connect, disconnect, and abort requests

- Receipt and processing of incoming and outgoing data

- Detection of network disconnects and failure of the transport layer to deliver data in a timely manner

FTP is the Internet standard, high-level protocol for transferring files from one machine to another. The server side requires a client to supply a login identifier and password before it will honor file transfer requests. This layer will comply with the FTP standard as specified in the Internet request for comment (RFC).

The FTP protocol governing this layer is described in the *File Transfer Protocol* (Reference 6) and the *WINS TCP/IP Primer* (Reference 7).

5.2   MOC to IAS Transmissions

The MOC uses FTP to transfer the definitive ephemeris, the telemetry trending analysis reports, the AN/DN files, and the event schedules reports from the MOC to the IAS. The MOC uses the FTP PUT command to place the files in a designated directory on the IAS computer. The MOC uses electronic mail to transfer the imaging impact reports to the IAS. The MOC FOT notifies any IAS operator by telephone if any files cannot be transferred.

5.3   IAS to MOC Transmissions

The IAS uses FTP to transfer the calibration parameter files, the calibration scene requests, and the problem reports from the IAS to the MOC. The IAS uses the FTP PUT command to place the files in a designated directory on the MOC computer. The IAS operator notifies the MOC FOT by telephone if the files cannot be transferred.

Section 6. Transport Layer

The transport layer provides a system-independent, process-to-process communications service in association with the underlying services provided by the lower layers. The transport layer permits two systems to exchange data reliably and sequentially, regardless of their location within a network.

TCP is the standard transport-level protocol that provides the reliable, full duplex, stream service on which many application protocols depend. TCP allows a process on one machine to send a stream of data to a process on another. It is connection oriented (i.e., before transmitting data, participants must establish a connection). This layer complies with the TCP standard as specified in the Internet RFC.

The TCP protocol governing this layer is described in the *Transmission Control Protocol* (Reference 8) and the *WINS TCP/IP Primer* (Reference 7).

Section 7. Network Layer

The network layer provides transparent data transfer between two transport layer entities. The network layer accepts packets from the transport layer at the source node and forwards them to the destination node.

IP is the Internet standard protocol that defines the Internet datagram as the unit of information passed across the Internet and provides the basis for the Internet connectionless, best-effort packet delivery service. This layer complies with the IP standard as specified in the Internet RFC.

The IP protocol governing this layer is described in *Internet Protocol* (Reference 9) and *WINS TCP/IP Primer* (Reference 7).

Section 8. Data Link Layer

The data link layer creates the communications path between adjacent nodes and ensures the integrity of the data transferred between them. Functions covered by this layer include

- Establishing and terminating the link

- Detecting and responding to link transmission errors

- Synchronizing link data transmissions and reporting link status

The protocol governing this layer is the standard for transmitting IP datagrams over Ethernet networks. The IP datagram is the basic unit of information passed across the Internet. It contains a source and destination address along with data. This layer complies with the IP datagram Internet standards as specified in the Internet RFCs.

Section 9. Physical Layer

The physical layer manages the physical transmission of data over a channel, which includes

- Monitoring change signals

- Handling hardware interrupts

- Informing the data link layer when transmission is complete

The MOC uses a standard 802.3 LAN, connected to MODNET/NOLAN. Nascom provides connections between the MODNET/NOLAN and the IAS network for MOC and IAS electronic communications.

Appendix A. Sample Files

This appendix provides samples of the following files which are exchanged by the MOC and the IAS:

- Telemetry trending analysis report

- Imaging impact report

- Event schedules report

- Problem report

Figure A-1. Sample Telemetry Trending Analysis Report (1 of 2)

Figure A-1. Sample Telemetry Trending Analysis Report (2 of 2)

```
========================================================================
Imaging Impact Report

-Report Date:   7/14/98
-Originator:  Tom Cooke, FOT
-Contact Information:  Phone (301) 614-5210  Fax (301) 614-5263
-Event:   Spacecraft Orbit Adjust Maneuver (Delta-V)
-Event Date:  7/30/98
-Event Time:  13:45 GMT
-Impact Duration:  13:00 - 18:00 GMT
-Description of Event:  The maneuver is necessary to keep the spacecraft
within WRS groundtrack requirements.
-Comments:  The Impact Duration depends on how long it takes the spacecraft to
converge and transition back to Precision Attitude Determination.  18:00 GMT
is our current estimate.  A post-maneuver report will be issued containing the
actual times.

========================================================================
```

Figure A-2. Sample Imaging Impact Report

```
        ======== LS7 Event Report: IAS Event Schedules Report ========

        Schedule   : OPERATIONAL
        Time Range : 1997:139:00:00:00 - 1997:142:00:00:00

Start Time               End Time                    Event Description

1997:140:07:45:51        1997:140:07:46:15        71/20
  Cal Type                               = PAC
  Gain-Setting                           = HHHHHHHHH
  Orbit Number                           = 149
  Playback Time                          = 1997:140:22:01:01
  Priority-Base                          = 99
  Priority-Dynamic                       = 297
  Region                                 = Alaska (USA)
  Request Type                           = PAC
  RequestId                              = 37513
  Scene-Id                               = 37219
  To Station                             = AGS
  WRS                                    = 71/20

1997:140:07:46:15        1997:140:07:46:39        71/21
  Cal Type                               = GLC
  Gain-Setting                           = HHHHHHHHH
  Orbit Number                           = 149
  Playback Time                          = 1997:140:23:01:01
  Priority-Base                          = 99
  Priority-Dynamic                       = 297
  Region                                 = Alaska (USA)
  Request Type                           = GLC
  RequestId                              = 37513
  Scene-Id                               = 37220
  To Station                             = LGS
  WRS                                    = 71/21

1997:140:07:46:39        1997:140:07:47:03        71/22
  Cal Type                               = FAC
  Gain-Setting                           = HHHHHHHHH
  Orbit Number                           = 149
  Playback Time                          = 1997:140:23:04:01
  Priority-Base                          = 99
  Priority-Dynamic                       = 297
  Region                                 = (unknown)
  Request Type                           = FAC
  RequestId                              = 37513
  Scene-Id                               = 37221
  To Station                             = SGS
  WRS                                    = 71/22
```

Figure A-3. Sample Event Schedules Report

```
IAS Problem Report
Date: 12/15/98
IAS Analyst:  Annie List        Phone: 605-555-xxxx
IAS Manager: Manny Guerre       Phone: 605-555-yyyy

Description of Problem:
Scan line misalignment is increasing over time within the specified scenes.
MSCD values of the scan line corrector mirror are not providing adequate error
model to correct for the effects.
-> Multiple pages of text, graphs, and tables describing the data and analyses
performed to date including, processing configurations, potential causes, and
further data and analyses needed.

Date of first occurrence: November 23, 1998

Scene Ids: 9811230027- 34/22 (WO#I1375), 9812080003-76/219 (WO#I1398),
9812120175-112/37 (WO#I1432)


Request for telemetry trending report:
Please provide trending data and plots of the following telemetry parameters
for the time frames associated with the above mentioned scenes.

Start Time                              Stop Time
330:11:31:12.000.000 - 330:11:31:46.000.000
348:16:17:09.000.000 - 351:16:18:04.000.000
352:22:13:45.000.000 - 352:22:14:45.000.000


Please report back using the finest granularity available from the spacecraft
telemetry.

Parameters:
SLC 1 Drive current
SLC 1 Electronics Temp.
Scan line corrector 1 on
SLC 2 Drive Current
SLC 2 Electronics Temp.
Scan Line Corrector 2 on
SMA Circuit
SMA Direction
SMA Elect Temp.
SMA Mode
```

Figure A-4. Sample Problem Report

```
REPORT HEADER:
--------------
 Input File:    /home/ls7/ops/output/subsets/super_comm/GTASTEST_059:03:43:29.bin
 Output File:   /home/gtas/gtas/report_output/test5.1.asc
 Created:       1997/118/14:09:53.000
 Start Time:    1997/059/01:23:22.550
 Stop Time:     1997/059/13:49:51.222
```

TIME	MPSEMIACS EU	MPSEMIBT1HI EU	MPSEMIBT1LO EU	MPSEMIBT2HI EU	MPSEMIBT2LO EU	MPSEMIBT3HI EU	MPSEMIBT3LO EU
1997/059/01:23:22.550	4.24000,						
1997/059/01:23:22.614		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/01:23:22.646	4.24000,						
1997/059/05:04:01.014		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:01.142		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:01.174	4.24000,						
1997/059/05:04:01.270		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:01.398		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:01.430	4.16000,						
1997/059/05:04:01.462		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:01.526		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:01.654		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:01.686	4.16000,						
1997/059/05:04:01.782		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:01.910		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:01.942	4.24000,						
1997/059/05:04:02.038		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:02.166		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:02.198	4.24000,						
1997/059/05:04:02.294		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:02.422		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:02.454	4.24000,						
1997/059/05:04:02.486		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:02.550		-7.62500,		-7.20000,		-7.60000,	
1997/059/05:04:02.678		-7.62500,	3.06000,	-7.20000,	3.06000,	-7.60000,	3.06000,
1997/059/05:04:02.806		-7.62500,		-7.20000,		-7.60000,	

Figure A-1. Sample Telemetry Trending Analysis Report (1 of 2)

```
1997/059/05:04:02.934            -7.62500,   3.06000,   -7.20000,   3.06000,   -7.60000,   3.06000,
1997/059/05:04:02.966 4.16000,
1997/059/05:04:03.062            -7.62500,              -7.20000,              -7.60000,
1997/059/05:04:03.190            -7.62500,   3.06000,   -7.20000,   3.06000,   -7.60000,   3.06000,
1997/059/05:04:03.222 4.24000,
1997/059/05:04:03.318            -7.62500,              -7.20000,              -7.60000,
1997/059/05:04:03.446            -7.62500,   3.06000,   -7.20000,   3.06000,   -7.60000,   3.06000,
1997/059/05:04:03.478 4.24000,
1997/059/05:04:03.510            -7.62500,              -7.20000,              -7.60000,
1997/059/05:04:03.574            -7.62500,              -7.20000,              -7.60000,
1997/059/05:04:03.702            -7.62500,   3.06000,   -7.20000,   3.06000,   -7.60000,   3.06000,
1997/059/05:04:03.734 4.24000,
```

Figure A-1. Sample Telemetry Trending Analysis Report (2 of 2)

Abbreviations and Acronyms

AN	ascending node
ASCII	American Standard Code for Information Interchange
CCB	Configuration Control Board
COTS	commercial off-the-shelf
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
DN	descending node
EDC	EROS Data Center
EROS	Earth Resources Observation System
ETM+	Enhanced Thematic Mapper Plus
FAC	full aperture calibrator
FDDI	fiber-distributed data interface
FDF	Flight Dynamics Facility
FOT	Flight Operations Team
FTP	File Transfer Protocol
GMT	Greenwich mean time
GSFC	Goddard Space Flight Center
GTAS	Generic Trending and Analysis System
IAS	Image Assessment System
ICD	interface control document
IGS	international ground station
IP	Internet Protocol
ISO	International Organization for Standardization
LAN	local area network
LGS	Landsat 7 Ground Station
LOS	line-of-sight
LPS	Landsat 7 Processing System

LTP	long-term plan
MAC	media access control
MO&DSD	Mission Operations and Data Systems Directorate
MOC	Mission Operations Center
MODNET	MO&DSD Operational/Development Network
MOPSS	Mission Operations Planning and Scheduling System
MOSDD	Mission Operations and Systems Development Division
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NBR	Navigation Base Reference
NOAA	National Oceanic and Atmospheric Administration
NOLAN	Nascom Operational Local Area Network
OSI	Open Systems Interconnection
PAC	partial aperture calibrator
PCD	payload correction data
RFC	request for comment
STDN	Spaceflight Tracking and Data Network
TBS	to be supplied
TCP	Transmission Control Protocol
TDRS	Tracking and Data Relay Satellite
WRS	Worldwide Reference System